

WHAT IS CLAIMED IS:

1. A magnetic recording apparatus comprising a perpendicular magnetic recording medium having a perpendicular magnetization film formed either directly or via an intermediate layer on a magnetic back film having a plurality of soft magnetic films laminated therein and a recording-and reproducing head, wherein the saturation magnetization (B_{sm}) and a thickness (t) of the soft magnetic film closest to the perpendicular magnetization film in the magnetic back film, and the shortest bit length (B_{min}) in magnetic recording and the average saturation magnetization (M_s) of the perpendicular magnetic film have the relationship represented by $0.5B_{min} \cdot M_s \leq B_{sm} \cdot (t < 100 \text{ nm})$.

2. A magnetic recording apparatus comprising a perpendicular magnetic recording medium having a perpendicular magnetization film formed either directly or via an intermediate layer on a magnetic back film having a plurality of soft magnetic films laminated therein and a recording-and reproducing head, wherein the saturation magnetization (B_{sm}) and a thickness (T_m) of the m -th soft magnetic film in the magnetic back film, and the saturation magnetization (B_{sh}) and track width (Tw) of the magnetic pole material for the recording head have the relationship represented by $0.16B_{sh} \cdot Tw \leq \sum(B_{sm} \cdot T_m)$.

3. A magnetic recording apparatus comprising a perpendicular magnetic recording medium having a perpendicular magnetization film formed either directly or via an intermediate layer on a magnetic back film having a plurality of soft magnetic films laminated therein and a recording-and reproducing head, wherein the saturation magnetization (B_{sm}) and a thickness (T_m) of the m -th soft magnetic film

in the magnetic back film, and the saturation magnetization (Bsh) and track width (Tw) of the magnetic pole material for the recording head have the relationship represented by $\Sigma(Bsm \cdot Tm) \leq Bsh \cdot Tw$.

5 4. The perpendicular magnetic recording apparatus according to claim 1, wherein the soft magnetic films of the perpendicular magnetic recording medium contain Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-C, Fe-Si-Al, Fe-Co-C, Co-Nb-Zr, Co-Mo-Zr, Co-Ta-Zr, Co-W-Zr, Co-Nb-Hf, Co-Mo-Hf, Co-Ta-Hf and Co-W-Hf alloys.

10 5. The perpendicular magnetic recording apparatus according to claim 2, wherein the soft magnetic films of the perpendicular magnetic recording medium contain Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-C, Fe-Si-Al, Fe-Co-C, Co-Nb-Zr, Co-Mo-Zr, Co-Ta-Zr, Co-W-Zr, Co-Nb-Hf, Co-Mo-Hf, Co-Ta-Hf and Co-W-Hf alloys.

15 6. The perpendicular magnetic recording apparatus according to claim 3, wherein the soft magnetic films of the perpendicular magnetic recording medium contain Fe-Si-B, Fe-B-C, Fe-B-C-Si, Fe-Ta-C, Fe-Si-Al, Fe-Co-C, Co-Nb-Zr, Co-Mo-Zr, Co-Ta-Zr, Co-W-Zr, Co-Nb-Hf, Co-Mo-Hf, Co-Ta-Hf and Co-W-Hf alloys.

20